Hawaiian Collembola

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(Presented by R. H. Van Zwaluwenburg at the meeting of Nov. 5, 1931)

The main purpose of this paper is to provide the entomologists of Hawaii with names for the Collembola of their pineapple and sugar cane soils. Some of these insects are known to damage the roots of those plants.

This article deals with twenty-seven species, of which eighteen are new. One new variety and two new genera, Stachia and Denisia, are described.

Hitherto the only Collembola known from Hawaii have been the five species described by Dr. G. H. Carpenter. The present considerable additions to the Hawaiian fauna are due mostly to the active interest of Mr. R. H. Van Zwaluwenburg.

Most of the type material upon which this paper is based has been deposited with the Hawaiian Entomological Society, Honolulu. In addition, specimens of most of the species have, by permission, been given to the U. S. National Museum.

A considerable proportion of these Hawaiian forms have their nearest allies in the East Indies, India and China, and a few of the species are cosmopolitan in distribution.

At present it is impossible to name species of Collembola as being endemic to the Hawaiian Islands, on account of our insufficient knowledge of the collembolan faunae of other regions. The non-endemic species may have been brought to the Islands by natural or by artificial means. Some idea of the extent to which Collembola are distributed commercially (most commonly in shipments of plants or plant products, and especially in soil) may be gathered from the fact that the Plant Quarantine and Control Administration (formerly the Federal Horticultural Board) has intercepted, through its inspectors at ports of the United States, thousands of specimens of Collembola, representing hundreds of species; these from all parts of the world.

In the descriptions that follow a few often-used expressions have been abbreviated. *Ant. 1,* for example, means the first an-

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tennal segment; *th. 2,* the second thoracic segment; *abd. 3,* the third abdominal segment.

The keys that follow are limited in scope to the known species of Hawaiian Collembola, including those described by Carpenter.

SYNOPSIS OF THE LARGER GROUPS OF THE ORDER COLLEMBOLA

1. Body elongate, segmentation evident. Suborder ARTHROPLEONA 2

   Body globular, segmentation obscure. Suborder SYMPHYPLEONA 9

2. Body segments essentially similar; prothorax similar to the other segments and with setae dorsally; never reduced or naked. Postantennal organ usually present. Antennae short, four-segmented. Mouth parts biting or piercing-suctorial. Unguiculus frequently absent. Furcula present or absent; when present, clearly appended to the fourth abdominal segment. Manubrium without setae ventrally. Anal spines often present. Integument tuberculate, weak, not hardened in the form of sclerites. Scales absent. Family PODURIDAE 3

   Body segments usually dissimilar; prothorax usually reduced, always membranous, without dorsal setae, and usually partly or entirely covered by the mesonotum. Postantennal organs present in Isotominae, absent in the other groups. Antennae usually long, four to six segmented. Mouth parts biting, Furcula present with few exceptions, often appended apparently to the fifth abdominal segment. Manubrium usually with setae or scales ventrally. Anal spines rarely present. Integument usually smooth, and hardened to form sclerites. Tergites usually imbricate. Scales present or absent. Family ENTOMOBRYIDAE 6

3. Head and body without pseudocelli. Eyes present or absent. Postantennal organ usually present. Unguiculus present or absent. Furcula present or absent. Sense organ of ant. 3 with sense rods, but without sense clubs and outer papillae 4

   Head and body with pseudocelli. Eyes absent. Postantennal organs almost always present and well developed. Mouth parts biting; mandibles with molar surface. Furcula absent or rudimentary. Sense organ of ant. 3 with sense rods, sense clubs, and often with outer papillae with guard setae. Anal spines usually present. Subfamily ONYCHIURINAE ....., p. 57

4. Mouth parts biting, not projecting in a cone; mandibles with molar surface. Furcula present. Anal spines usually present. Subfamily ACHORUTINAE ....., p. 53

   Mouth parts biting or piercing-suctorial, projecting in a cone in most of the genera; mandibles small or absent, without molar surface. Subfamily NEANURINAE 5

5. Anal segment relatively small; supra-anal valve rounded, not bilobed. Furcula present or absent. Segmental tubercles absent. Tribe PSEUDACHORUTINI ....., p. 55

Anal segment relatively large; supra-anal bivalve bilobed. Unguiculus absent. Furcula absent. Segmental tubercles present. Buccal cone present. Anal spines absent. Tribe NEANURINI....., p. 56

6. Postantennal organs almost invariably present (absent in *Isotoma minor*). Third and fourth abdominal segments not greatly different in median dorsal length. Mesonotum not projecting over the head. Inner margin of unguis simple. Scales absent. Body setae simple; occasionally unilaterally feathered. Subfamily ISOTOMINAE ....., p. 58

Postantennal organs absent. Fourth abdominal segment much longer than the third. Mesonotum often projecting over the head. Inner margin of unguis split. Scales present or absent. Body setae of various types, including setae finely fringed on all sides. Subfamily ENTOMOBRYINAE..... 7

7. Dentes slender, dorsally annulated. Mucro short, relatively small, with apical tooth, anteapical tooth and basal spine; or falcate. Tribe ENTOMOBRYINI ....., p. 64

Dentes not dorsally annulated..... 8

8. Dentes without two rows of dorsal feather-like scales. Mucro robust, with dissimilar inner and outer margins. Antennae unusually long. Eyes present. Tribe PARONELLINI....., p. 71

Dentes with two rows of dorsal feather-like scales. Mucro elongate, slender, with similar margins. Antennae relatively short. Eyes absent. Scales present. White species. Tribe CYPHODERINI ....., p. 71

9. First four abdominal segments ankylosed. Antennae inserted on the posterior half of the head, and longer than the head. Family SMINTHURIDAE 10

10. Vesicles of ventral tube with smooth walls. Thoracic segmentation indicated dorsally. Subfamily SMINTHURIDINAE....., p. 72

Vesicles of ventral tube with tuberculate walls. Thoracic segmentation absent..... 11

11. Antennae bent between segments three and four. Ant. 4 longer than ant. 3, and subsegmented. Subfamily SMINTHURINAE....., p. 73

Antennae bent between segments two and three. Ant. 4 shorter than ant. 3; both, or only the fourth segment, subsegmented. Subfamily DICYRTOMINAE....., p. 74

Subfamily ACHORUTINAE Börner

KEY TO GENERA

Furcula well developed. Eyes sixteen. Postantennal organs present. .....SCHÖTTELLA, p. 54

Furcula small. Eyes ten. Postantennal organs absent.....XENYLLA, p. 54

Genus SCHÖTTELLA Schäffer

Schöttella alba new species. (Plate 1, figs. 1-4).

White. Eyes (fig. 1) remote from antennae, eight on each side, equal, distant from one another, without pigment. Postantennal organ (fig. 1) with five subequal lobes, forming a rosette. Mandibles present, with well-developed molar surfaces. Antennae shorter than the head, with several olfactory setae (fig. 2). Unguis (fig. 3) untoothed. Unguiculus absent. Tenent hairs absent. Dens (fig. 4) with three dorsal setae. Mucro (fig. 4) about one-third as long as dens, stout, in lateral aspect rounded apically, with broad rounding inner lamella. Anal spines absent. Clothing of very few short stiff setae, in two transverse rows on most of the body segments. Integument tuberculate. Length, 0.8 mm.

Honolulu, October 8, 1927, from pineapple roots (J. F. Illingworth).

Genus XENYLLA Tullberg

Xenylla sensilis new species. (Plate 1, figs. 5-13).

Dorsally mottled with blue pigment; ventrally pale. Eyes (fig. 5) five on each side, on black patches. Postantennal organs absent. Antennae shorter than the head (as 9:13). Ant. 3 organ (fig. 6) with a pair of clavate papillae under a tuberculate, rounded, integumentary fold and between a pair of slightly curving accessory horns, each of which is subtended by a seta. Ant. 4 with distal sensory cones as in figure 7. Unguis (fig. 8) apparently unidentate in lateral aspect; actually with a pair of teeth side by side as in figure 9. Tenent hairs 1, 2, 2. Anal spines (fig. 10) minute. Dens (fig. 11) with two dorsal setae. Mucro (figs. 11, 12) seven-tenths as long as dens, distally produced and slightly curving, apically rounded; lamella broad, terminating before the apex. Rami of tenaculum tridentate. Body setae (fig. 13) few, minute, simple. Integument tuberculate. Length, 0.8 mm.

This species is near *X. welchi* Folsom (1916, p. 497) from which it differs chiefly in the structure of the antennal sense organs.

Honolulu, October 4, 1928, pineapple soil (J. F. Illingworth).

Xenylla alba new species. (Plate 2, figs. 14-20).

White. Eyes (fig. 14) five on each side, on black spots; ocular pigment sparse. Postantennal organs absent. Antennae two-thirds as long as the head. Ant. 3 organ (fig. 15) with a pair of elongate rods and two guard setae. Ant. 4 with distal sensory cones as in figure 16; olfactory setae slender, curving, not much differentiated from the other setae. Unguis (fig. 17) stout, curving, untoothed. Tenent hairs 1, 2, 2. Anal spines (fig. 18) minute. Dens with two setae. Mucro (figs. 19, 20) from one-half to three-fourths as long as dens, distally produced and curving upward, apically rounded; inner lamella broad, ending before the apex. Body setae very few, minute, curving, simple. Integument tuberculate. Length, 0.8 mm.

Honolulu, October 8, 1927, among pineapple roots (J. F. Illingworth).

Tribe PSEUDACHORUTINI Börner

Genus STACHIA new genus

(Plate 2, figs. 21-26; Plate 3, figs. 27-30)

Elongate, minute. Eyes reduced in number. Postantennal organ trilobed. Antennae shorter than the head, conical, four-segmented. Ant. 4 with a terminal sensory tubercle. Buccal cone present. Mouth parts piercing. Body segments not demarcated from one another by sutural lines. Prothorax not reduced. Anal segment simple, rounded; anus caudal; anal valves subtriangular in outline. Unguiculus absent. Furcula rudimentary. Integument tuberculate. Large segmental tubercles absent. Genotype, *Stachia minuta* Folsom.

This generic description, being based on a single species, may need future modification.

This peculiar genus belongs in Pseudachorutini but comes close to none of the described genera of that tribe. Its trilobed postantennal organs are like those of Xenyllodes and its mandibles and maxillae are similar in plan to those of Micranurida (Börner, 1901, p. 703). The maxilla is exactly like that of *Neanura* (*Achorutes*) *muscorum* (Folsom, 1916, pl. 23, fig. 225) except in having a relatively shorter head.

On the whole, the genus may be placed near Micranurida.

This new genus is named for Dr. Jan Stach, the esteemed Polish authority on Collembola.

Stachia minuta new species. (Plate 2, figs. 21-26; Plate 3, figs. 27-30).

White throughout, elongate (fig. 21), minute, with intersegmental grooves instead of sutures. Eyes consisting of a single cornea on each side of the head, close to the base of the antenna (fig. 22) and without pigment. Close to each eye is the trilobed postantennal organ (fig. 23) situated in a pit formed by an integumentary ridge. Antennae less than half as long as the head, stoutly conical, four-segmented. Ant. 4 with a terminal sensory tubercle; special olfactory setae absent. Buccal cone present, broadly triangular in ventral aspect. Mouth parts piercing; mandible distally (fig. 24) semi-sagittate, with a sharply pointed apex and a sharp subapical barb like that of a fishook; secondary teeth absent; maxilla (fig. 25) with a simple piercing apex. Body segments in relative lengths about as 12 : 20 : 18 : 14 : 13 : 12 : 13 : 11 : 8; prothorax relatively large; anal segment (fig. 26) simple, rounded, without anal spines; anus caudal; anal valves (fig. 27) subtriangular in outline. Legs short and stout. Unguis (fig. 28) stout, subfalcate, untoothed. Unguiculus absent. Tenent hairs absent. Ventral tube small, with a pair of hemispherical vesicles side by side. Furcula present but greatly reduced (figs. 29, 30), being a simple bilobed organ in

which manubrium, dentes and mucrones are not demarcated from one another. Tenaculum apparently absent. Body setae very few, minute, short and stiff, in a single row across the middle of most of the body segments, being rather numerous and larger on the genital and anal segments. Integument tuberculate, the tubercles becoming larger and irregular on the genital and anal segments. Large segmental tubercles absent. Length, 0.5 mm.

Wahiawa, Oahu, July 12, August 12, October 2, 4, 1928, abundant deep in pineapple soil with Onychiurus, Japyx, Symphyla, etc. (J. F. Illingworth); Honolulu, in many soil samples (R. H. Van Zwaluwenburg); Tantalus, Oahu, August 4, 1930, soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Cotypes.—Cat. No. 43764, U. S. N. M.

Tribe NEANURINI Börner

KEY TO GENERA

Head of maxilla with toothed lamellae.....PROTANURA
Head of maxilla needlelike, without lamellae.....NEANURA

Genus PROTANURA Börner

Protanura capitata new species. (Plate 3, figs. 31-36).

White (fig. 31). Head with a postero-lateral tubercle on each side. Eyes and postantennal organs absent. Antennae a little shorter than the head. Ant. 3 and 4 confluent dorsally but demarcated by a suture ventrally. Ant. 3 organ (fig. 32) simple, with a pair of ovate papillae. Ant. 4 with distal olfactory setae as in figure 33. Buccal cone present. Mandible distally (fig. 34) with large teeth, laciniate appendage and long linear stalk. Head of maxilla (fig. 35) with coarsely toothed galea and finely toothed lacinial membranes. Segmental tubercles in dorsal aspect: 6, 8, 8, 8, 8, 8, 6, 4, 2; the dorsal tubercles much less prominent than in figure 31. Unguis (fig. 36) with a pair of inner teeth side by side, one-third from the base. Tenent hairs absent. Anal spines and furcula absent. Anus ventral. Clothing of short simple setae and long capitate hairs. Integument tuberculate, not reticulate. Length, 3 mm.

This species is quite distinct from the four other species of Protanura.

Honolulu, September 13, 1930 (Walter Carter).

Genus NEANURA MacGillivray

Neanura citronella Carpenter.
See Carpenter, 1904, p. 303.

Subfamily ONYCHIURINAE Börner

KEY TO GENERA

Body stout or moderately slender, head broad. Tubercles of postantennal organ usually not numerous. Sense clubs of ant. 3 smooth or tuberculate, not bending toward each other. Unguiculus well developed. ..... ONYCHIURUS

Body quite slender, head narrow. Tubercles of postantennal organ usually numerous. Sense clubs of ant. 3 smooth, bending toward each other. Unguiculus reduced and setaceous, or absent..... TULLBERGIA

Genus ONYCHIURUS Gervais

Onychiurus fimetarius (L., Lubb.).

For a description of this species see Folsom, 1917, p. 649.

The Hawaiian specimens of this species agree accurately with examples from Europe and North America. The species, common throughout Europe and widely distributed in North America, is known also from Algeria, Sumatra, and China.

Olaa, Hawaii, soil in sugar cane fields (R. H. Van Zwaluwenburg).

Genus TULLBERGIA Lubbock

Tullbergia silvicola new species. (Plate 4, figs. 37-41).

White. Slender (fig. 37), six times as long as broad. Postantennal organs (fig. 38) subelliptical, each with about 60 tubercles. Pseudocelli large, thick-walled. Head with a pseudocellus just in front of each postantennal organ. Antennal base not differentiated. Antennae two-thirds as long as the head; third and fourth segments confluent. Ant. 3 organ (fig. 39) with four guard setae, two minute sense rods, and two subreniform smooth sense clubs curving toward each other. Ant. 4 with six or more strongly curving olfactory setae. Body with a pair of dorsal pseudocelli on segments th. 2 to abd. 5, inclusive (fig. 37). Unguis (fig. 40) stout, curving, untoothed. Unguiculus rudimentary, spiniform. Anal spines (fig. 41) two, slender, arcuate, four-fifths as long as hind unguis, on contiguous papillae. Clothing of minute stiff simple setae; the sensory setae longer. Integument tuberculate. Length, 0.7 mm.

In the pseudocelli of the head the wall is often interrupted, as in figure 38.

Tantalus, Oahu, August 4, 1930, soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Subfamily ISOTOMINAE Börner

KEY TO GENERA

1. Body cylindrical, greatly elongate. Prothorax unusually long. Abd. 4 a simple ring. Terga not imbricate. Furcula very small. Eyes reduced in number or absent. Postantennal organs long and narrow. Manubrium longer than dentes 2
   Body not greatly elongate. Prothorax reduced more or less. Abd. 4 modified. Terga imbricate. Furcula not very small 3
2. Genital and anal segments simple, or relatively unmodified, without ankylosis. Anus not ventral. Manubrial hooks not strongly developed. Integument smooth ..... FOLSOMIDES, p. 58
   Genital and anal segments modified, shortened, ankylosed. Anus ventral. Manubrial hooks strongly developed. Integument granulate. ..... ISOTOMODES, p. 59
3. Last three abdominal segments ankylosed, forming a single mass. Anus ventro-caudal. Eyes reduced in number or absent. Body pigment weak or absent 4
   Last three abdominal segments not ankylosed. Anus caudal. Eyes usually sixteen. Pigment commonly well developed 5
4. Mucro bidentate. Ant. 4 without sense clubs ..... FOLSOMIA, p. 60
   Mucro falcate. Ant. 4 with sense clubs ..... DENISIA, p. 61
5. Third abdominal tergite shorter than the fourth, and not ventrolaterally prolonged backward. Furcula not attaining the ventral tube. ..... PROISOTOMA, p. 62
   Third abdominal tergite longer than the fourth, and ventrolaterally prolonged backward. Furcula attaining the ventral tube 6
6. Abdominal fringed bothriotricha present. Mucrones lamellate. ..... ISOTOMURUS, p. 63
   Bothriotricha absent. Mucrones not lamellate ..... ISOTOMA, p. 63

Genus FOLSOMIDES Stach

Folsomides exiguus new species. (Plate 4, figs. 42-47).

White. Greatly elongate (fig. 42). Eyes two on each side, pigmented separately, one behind the other, the posterior eye being the smaller. Postantennal organ (fig. 43) near the anterior eye, elongate, six to seven times as long as broad, feebly curving, with three or four posterior guard setae; from two-thirds to one and one-third times as long as the basal width of ant. 1. Antennae two-thirds as long as the head, with stout segments in relative lengths about as 16 : 24 : 25 : 42. Sense organ of ant. 3 with a pair of papillae, each arising from the bottom of a deep pit. Ant. 4 with several slender curving olfactory setae, without terminal tubercle. Mandible with a molar surface (fig. 44). Body segments in relative lengths about as 9 : 32 : 27 : 23 : 23 : 23 : 25 : 18 : 17; or 10 : 34 : 28 : 20 : 23 : 24 : 29 : 20 : 18. Body segments without ankylosis. Anus caudal. Unguis (figs. 45, 46) stout, curving, simple, untoothed. Unguiculus of hind feet (fig. 45) lanceolate, acuminate, extending about one-fourth as far as the unguis; on fore and mid-feet, a minute pointed rudiment (fig. 46). Tenent

hairs absent. Ventral tube with a pair of hemispherical vesicles, side by side. Furcula small, appended evidently to abd. 4, and extending only slightly beyond the anterior border of that segment. Manubrium (fig. 47) stout, with four pairs of dorsal setae, without ventral setae. Mucrodentes (fig. 47) three-fourths or three-fifths as long as manubrium, with three dorsal setae, no ventral setae, and minutely bidentate: apical tooth hooked; anteapical tooth larger, erect or inclined slightly forward. Rami of tenaculum tridentate; corpus with a small median anterior lobe and one seta. General clothing of a few rows of short stiff simple setae in the middle region of most of the body segments; sensory setae longer, erect, simple. Integument smooth. Maximum length, 0.7 mm.

This new species differs in many respects from the genotype, *F. parvulus* Stach (1922, p. 17), from Hungary.

Honolulu, March 25, 1925, in sugar cane soil; November 26, 1928, in rice soil (R. H. Van Zwaluwenburg); October 8, 1927, in pineapple soil (J. F. Illingworth); Tantalus, Oahu, August 4, 1930, in soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Cotypes.—Cat. No. 43765, U. S. N. M.

Genus Isotomodes Axelson

Isotomodes denisi new species. (Plate 5, figs. 48-56).

White throughout. Very elongate (fig. 48). Eyes absent. Postantennal organs (fig. 49) elliptical, three times as long as wide, three-fourths as long as the basal width of ant. 1, with guard setae as in figure 49, there being none near the anterior border of the organ. Antennae slightly longer than the head, with segments about as 4 : 5 : 6 : 9. Sense organ of ant. 3 consisting of a pair of sacs, the walls of which are circular in deep optical cross-section (fig. 50), and shaped like the figure 8 at the level of the integument (fig. 51). Each sac contains a single papilla (fig. 52) and is covered externally by a hemispherical tubercle. Ant. 4 with several (at least 5) curving olfactory pegs (fig. 52), without a terminal tubercle and without a subapical papilla. Mandibles and maxillae as in figures 53 and 54. Prothorax relatively long. Genital and anal segments ankylosed, with a short obsolete dorsal suture. Body segments in relative lengths about as 9 : 22 : 20 : 14 : 13 : 16 : 20 : 5+6. Anus ventral. Femora with a partial distal subsegment, the transverse suture being limited to the lower side of the femur. Unguis (fig. 55) stout, almost straight, untoothed. Unguiculus extending almost half as far as the unguis, oblong-lanceolate and acute on the hind feet, smaller and more sharply pointed on the other feet. Tenent hairs absent. Ventral tube with a pair of rounded vesicles side by side. Furcula small, extending only to the middle of abd. 3. Manubrium stout, longer than dentes (as 4 : 3 or 5 : 3), ventrally naked, dorsally with many stiff setae (20 or more). Manubrial hooks strongly developed (fig. 56). Dens (fig. 56) not annulate; dorsally with only two setae, situated near the base of the dens and erect, the proximal

seta long and strong, and the distal seta much smaller; dens ventrally with only one seta as a rule, rarely with two or three; manubrial hooks strongly developed. Mucrones (fig. 56) one-third as long as dentes, three-quarters as long as hind ungues, bidentate; anteapical tooth larger than the apical. Rami of tenaculum tridentate; corpus with one strong curving anterior seta. General clothing of a few rows of short stiff simple setae across the middle region of a body segment, being abundant and stronger at the end of the abdomen; sensory setae longer, erect, simple, in a single transverse row on most of the body segments. Integument smooth. Maximum length, 1.7 mm.

This species differs in several respects from *Isotomodes productus* Axels., known from Finland, Russia, France, England and Morocco. *I. productus* (Linnaniemi, 1912, p. 107; Denis, 1923, p. 243; Handschin, 1925*a*, p. 164) is described as having at least 14 or 15 olfactory setae on ant. 4; postantennal organ longer than the basal width of ant. 1, and with 6 posterior and 3 anterior guard setae; abd. 3 and 4 equal in length; dens with only one ventral seta; mucro one-fourth as long as dens; integument granulate.

A variety of *productus* was named *trisetosa* by Denis on account of its having three ventral setae on each dens. In this new species different individuals may show one, two, or three such setae, though only one as a rule.

Honokaa, Hawaii, November 5, 1928, in cane soil; Honolulu. abundant in cane soil (R. H. Van Zwaluwenburg); Tantalus, Oahu, August 4, 1930, in soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

This new species is named for Dr. J. R. Denis, known for his exact and thorough studies of Collembola.

Cotypes.—Cat. No. 43766, U. S. N. M.

Genus Folsomia Willem

Folsomia fimetaria (L., Tull.).

My Hawaiian specimens of this species agree with European and North American examples except in having stouter ungues. The postantennal organs, very variable in form and size in this species, are narrowly subelliptical and about as long as the basal width of ant. 1. The specimens are all young individuals, being only 1 mm. in length.

For a description of this species see Folsom, 1902, p. 92.

This cosmopolitan species belongs to the fauna of the soil, being often found among the roots of plants, under damp wood, stones or bark, in moss, and not infrequently on well water. It occurs often in flowerpots in dwelling houses or greenhouses, having been brought in with the soil; and has been found in caverns and graves.

F. fimetaria is one of the commonest collembolans in northern and middle Europe and in the United States, in all parts of which it occurs, including California and Alaska. It is known also from Siberia, Spitzbergen, Franz Josef Land, Greenland, Mexico and Guatemala. It has often been intercepted in ports of this country by inspectors of the Plant Quarantine and Control Administration.

Honokaa and Olaa, Hawaii, soil in sugar cane fields (R. H. Van Zwaluwenburg).

Genus DENISIA new genus

(Plate 5, fig. 57; Plate 6, figs. 58-62)

Fourth, fifth, and sixth abdominal segments ankylosed, forming a single mass. Anus ventro-caudal. Mucrones falcate. Eyes and postantennal organs absent. Ant. 4 with relatively large sense clubs. Unguis and unguiculus untoothed. Tenent hairs absent. Body setae simple. Integument smooth. Genotype, *Denisia falcata* Folsom.

This new genus is evidently close to *Folsomia* Willem, from which it differs chiefly in having falcate mucrones and antennal sense clubs and in lacking postantennal organs. I dedicate it with pleasure to my colleague, Dr. J. R. Denis.

Denisia falcata new species. (Plate 5, fig. 57; Plate 6, figs. 58-62).

White (fig. 57). Eyes and postantennal organs absent. Antennae subequal to head in length, to one-fourth longer than head. Ant. 3 organ with a pair of small tubercles in a shallow depression. Ant. 4 with five or six distal dorso-lateral sense clubs (fig. 58) and a terminal tubercle. Mandibles with a well developed molar surface. Imbrication of body segments weak. Abd. 4, 5, and 6 ankylosed, without sutures in some individuals, but usually with an obsolete dorsal suture between abd. 4 and 5. Anus ventro-caudal. Unguis (fig. 59) simple, untoothed. Unguiculus extending about one-half as far as the unguis, broadly lanceolate, acute, untoothed. Knobbed tenent hairs absent. Furcula extending not quite to the ventral tube. Manubrium ventrally with five pairs of distal setae. Manubrial hooks not developed; there being two pairs of narrow chitinous ridges. Dens (fig. 60) slightly more than twice as long as manubrium, slender, tapering, crenulate dorsally on proximal half only; with very long ventral subapical seta; basodorsally with a long erect seta just anterior to a short seta. Mucrones (fig.

61) falcate. Rami of tenaculum quadridentate; corpus with one anterior seta, sometimes a pair of setae. Clothing (fig. 62) of abundant, short, stiff, simple setae, with long erect simple sensory setae; with a few long unilaterally fringed setae on the ankylosed abdominal segments. Integument smooth. Length, 0.65 mm.

Honolulu, January 7, 1927, in cane soil. April 5, 1927, from débris in nest of *Coptotermes formosanus* Shiraki (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43767, U. S. N. M.

Genus Proisotoma Börner

Proisotoma nigromaculosa new species. (Plate 6, figs. 63-66).

White, minutely and irregularly flecked with blackish blue, giving a pale grayish appearance. Antennae bluish throughout, or spotted with blackish; ant. 4 dark apically. Legs white with pigmented coxae, or spotted throughout with blackish. Furcula unpigmented. Antennae subequal to head in length, or slightly longer, with segments about as 4 : 5 : 6 : 9 or 7 : 13 : 12 : 23. Ant. 3 organ with a pair of simple rods subtended by a chitinous ridge. Ant. 4 with a terminal sensory tubercle and without specially differentiated olfactory setae. Eyes eight on each side (fig. 63), subequal, on black patches. Postantennal organ elliptical to subreniform, with or without an anterior notch at the middle, and three to three and one-half times as long as the diameter of an adjacent eye. Abd. 3 shorter than abd. 4 (as 5 : 6). Genital and anal segments usually not ankylosed, sometimes partially ankylosed. Tibiotarsi with an incomplete distal subsegment, indicated by a suture on the lower side. Unguis (fig. 64) untoothed. Unguiculus sublanceolate, untoothed, or with an inner tooth or angle, and extending from almost one-half to two-thirds as far as the unguis. Tenent hairs absent. Furcula not attaining the ventral tube; extending to the middle of abd. 2. Manubrium with one pair to three pairs of ventral subapical setae. Dentes one-third longer than manubrium, with coarse transverse dorsal folds, absent proximally and distally. Mucro (figs. 65, 66) subequally bidentate. Rami of tenaculum quadridentate; corpus with one anterior seta. Clothing of short, stiff, simple setae in the middle region of most of the body segments, absent in the intersegmental regions, with longer erect simple sensory setae. Integument smooth. Length, 0.9 mm.

This species is somewhat like the European *Proisotoma ripicola* Linnaniemi (1912, p. 128), from which it differs, however, in coloration, in having relatively much longer dentes, and in several other details.

Pupukea, Oahu, October 1, 1928, in pineapple soil (J. F. Illingworth); Honolulu, November 26, 1928, in rice soil (R. H. Van Zwaluwenburg).

Genus Isotomurus Börner

Isotomurus palustris (Müller), var. **balteatus** (Reuter).

The Hawaiian examples of this variety are typical in structure and coloration. For a description, see Schött, 1894, p. 66.

I. palustris is a common cosmopolitan species, highly variable in coloration. Its variety *balteatus* is known from Europe, many parts of the United States, including California, and from British West Indies and Bismarck Archipelago.

Honolulu, sugar cane soil, near the surface under trash, "78 per surface square foot" (R. H. Van Zwaluwenburg); Kauai, soil in sugar cane fields (R. H. Van Zwaluwenburg).

Genus Isotoma Bourlet

KEY TO SPECIES

Purplish yellow. Eyes sixteen. Tenent hair one.....*perkinsi*
White. Eyes, postantennal organs, and tenent hairs absent.....*minor*

Isotoma perkinsi Carpenter.

See Carpenter, 1904, p. 302.

Isotoma minor Schäffer. (Plate 6, figs. 67-71).

White throughout. Eyes and postantennal organs absent. Antennae about one-fourth longer than the head, with segments about as 3 : 7 : 7 : 10; third and fourth segments subclavate. Ant. 4 with six or seven relatively large olfactory cones or pegs, as in figures 67 and 68. Abd. 3 usually a little shorter than abd. 4 (as 9 : 11); sometimes subequal to it. Abd. 5 and 6 usually, but not always, ankylosed; anal valves large. Unguis (fig. 69) rather slender, untoothed. Unguiculus extending two-thirds as far as the unguis on the hind feet; about half as far on the remaining feet; broadly lanceolate, acute, untoothed. Tenent hairs absent. Furcula extending not quite to the ventral tube. Manubrium with several stiff dorsal setae and four to ten ventral subapical setae. Dens two and one-half times as long as manubrium, with a few erect dorsal setae and stiff oblique ventral setae; dorsally minutely crenulate on the proximal four-sevenths only. Mucro (fig. 70) tridentate; apical tooth slender; anteapical tooth erect; basal tooth lateral, spinelike; dens with a long lateral subapical seta. Rami of tenaculum quadridentate; corpus with one anterior seta. General clothing of rather long, stiff or curving, simple setae (fig. 71); outstanding sensory setae of abdominal segments much longer, doubly fringed, stronger on the posterior region of the abdomen. Length, 0.91 mm.

The Hawaiian examples of *I. minor* agree with European and North American representatives of the species in every detail except that in the Hawaiian specimens ant. 1 is relatively shorter, and the baso-lateral tooth of the mucro is slender and spinelike instead of being short and blunt.

I. minor, a species of the soil fauna, has been recorded from almost all parts of Europe, from the United States and from Mexico.

Honolulu, January 7, 1927, in cane soil (R. H. Van Zwaluwenburg).

Tribe ENTOMOBRYINI Börner

KEY TO GENERA

1. Body without scales 2
   Body with scales 3
2. Ungues with simple inner teeth. Tenent hair strongly developed. ..... ENTOMOBRYA, p. 64
   Ungues with large inner "wing-teeth." Tenent hair weak. ..... SINELLA, p. 66
3. Scales pointed apically, with long coarse striae. Dentes without scales. ..... SIRA, p. 66
   Scales rounded apically, with short fine close striae. Antennae not annulated 4
4. Mucro with two teeth and a basal spine ..... LEPIDOCYRTUS, p. 67
   Mucro falcate. ..... DREPANOCYRTUS, p. 69

Genus ENTOMOBRYA Rondani

KEY TO SPECIES

1. White throughout ..... *lactea,* p. 65
   Yellow with purple markings 2
2. Transversely banded ..... *multifasciata,* p. 64
   Not banded 3
3. Yellow with lateral purple stripes. Tenent hair present. Mucro with basal tooth ..... *insularis,* p. 64
   Yellow with complex purple markings. Tenent hair and basal tooth absent ..... *kalakaua,* p. 64

Entomobrya insularis Carpenter.
See Carpenter, 1904, p. 301.

Entomobrya kalakaua Carpenter.
See Carpenter, 1904, p. 301.

Entomobrya multifasciata (Tullberg), var. **imminuta** new variety. (Plate 7, figs. 72-75).

Yellow with transverse bands (fig. 72). The pigment is purple, appearing black where it is dense. Prothorax pigmented dorsally; mesonotum with an anterior band extending laterally, and a posterior marginal band; metanotum with a posterior band and a lateral marginal spot; first three abdominal segments each with a broad posterior band; abd. 4 with two dorsal bands, the posterior one being marginal; abd. 5 with a posterior

band; abd. 6 pigmented dorsally. Head with an irregular median frontal spot; behind this a V-shaped mark; occiput with a dorsal marginal mark. Antennal base blackish; ant. 1 and 2 each with an apical spot; ant. 3 dull purplish except basally; ant. 4 dull purplish throughout. First pair of legs unpigmented except on the precoxae; second and third pairs each with precoxal spots and a distal femoral spot. Furcula unpigmented. Eyes (fig. 73) sixteen, the two inner proximal eyes of each side smaller than the others. Antennae more than twice as long as the head. Body segments (omitting the prothorax) in relative lengths about as 20 : 21 : 19 : 18 : 19 : 25 : 12 : 7 or as 28 : 23 : 17 : 22 : 20 : 47 : 13 : 9. Unguis (fig. 74) stout, almost straight; inner border with a pair of large proximal teeth one-third from the apex, and a smaller distal pair. Unguiculus oblong-lanceolate, extending about two-thirds as far as the unguis. Tenent hair about as long as the unguis. Dentes slightly longer than the manubrium, the dorsal crenulations ending at a distance from the apex equal to three times the length of the mucro. Mucro (fig. 75) in lateral aspect strongly rounded ventrally, the anteapical tooth relatively low and broadly conical. Rami of tenaculum quadridentate; corpus with one strong curving anterior seta. Length, 1.6 mm.

In coloration this form agrees essentially with *multifasciata* Tull., a common species in Europe and North America. As compared with typical *multifasciata,* however, abd. 4 is relatively much shorter; the antennae relatively much longer; the proximal pair of teeth of the unguis is beyond the middle; and the two inner proximal eyes of each side are greatly reduced.

The posterior marginal bands of th. 2 to abd. 3, inclusive, are either continuous or else more or less interrupted along the median dorsal line—a variation that is common in *multifasciata,* both in Europe and North America.

In one individual the mid intestine contained an abundance of fungus spores and fragments of hyphae, the latter predominating.

Pupukea, Oahu, October 1, 1928, in pineapple soil (J. F. Illingworth).

Entomobrya lactea new species. (Plate 7, figs. 76-78).

Head and body usually white throughout, excepting the black eye spots and frontal ocellus. The largest individuals may have a narrow weak posterior purple band on abd. 1, 2, 3, 5 and 6. Ant. 1 and 2 purple apically, or ant. 1 unpigmented; ant. 3 pigmented apically or throughout; ant. 4 purple throughout. Femora pigmented apically; tibiotarsi throughout. Furcula unpigmented. Eyes (fig. 76) sixteen, unequal. Antennae four-fifths longer than the head, with segments about as 12 : 23 : 24 : 28, not annulated. Abd. 4 is two and one-half to three and one-half times as long as abd. 3. Unguis (fig. 77) slender, with two pairs of inner teeth and a pair of lateral teeth. Unguiculus extending about five-eighths as far as the unguis, oblong-lanceolate, acute, untoothed. Tenent hair equal to unguis in

length. Manubrium three-fifths as long as dentes. The non-annulated region of the dens is about one and two-thirds times as long as the mucro. Mucro (fig. 78) minute; apical and anteapical teeth hooked, subequal: basal spine present. Length, 1.3 mm.

Honolulu, September, 1930, behind sugar cane leaf sheaths, in trash, etc. (F. X. Williams).

Cotypes.—Cat. No. 43768, U. S. N. M.

Genus SINELLA Brook

Sinella höfti Schäffer. (Plate 7, figs. 79-81).

White. Eyeless. Antennae longer than the head (as 8 : 5). Abd. 4 two and one-fourth to two and two-thirds times as long as abd. 3. Unguis (fig. 79) with a large acute basal "wing-tooth," posterior in position, (when the leg is in a transverse plane); opposite this is an anterior linear thickening, which may or may not be pointed distally; just beyond this is either a tooth or an angle. A pair of small pseudonychia occurs near the base. Unguiculus extending two-thirds to four-fifths as far as unguis, with a large acute outer wing-tooth. Tenent hair as long as inner margin of unguis, not clubbed. On each tibiotarsus, one-third from the base, is a large subclavate fringed seta (fig. 80). Furcula with scales ventrally. Dens one-fifth longer than manubrium. Mucro (fig. 81) stout, falcate, with long basal spine. Length, 1.1 mm.

The specimens studied were not full grown.

The thickened fringed seta of the tibiotarsi I find in specimens from Iowa also.

As compared with European examples, the wing-tooth of the unguis is wider, and the opposite, or anterior, tooth is greatly narrowed or reduced to a ridge.

This species is known from China (Denis, 1929*b*, p. 311) and a variety of it (*S. coeca edenticulata*) has been described from Java (Handschin, 1926, p. 455). I think that *S. montana* Imms (1912, p. 101) from India is to be regarded as a variety of *höfti*.

Tantalus, Oahu, August 4, 1930, in soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Genus SIRA Lubbock

Sira jacobsoni Börner. (Plate 8, figs. 82-88).

When denuded of scales, yellow or whitish, marked with blackish purple (figs. 82, 83). Mesonotum pigmented throughout, or nearly so, the band extending to the bases of the coxae. Abd. 2 with a posterior band, sometimes narrow and somewhat irregular (fig. 83). Abd. 3 banded throughout dorsally, or with a narrow anterior unpigmented area. Abd. 4 banded

posteriorly; the band sometimes covering more than half of the dorsum, and always having an irregular anterior margin, often with irregular streaks of pigment projecting forward. Abd. 5 with a postero-dorsal spot, or unpigmented. Head with a median frontal spot, indicating the ocellus. Ant. 1 yellow or white, purple apically; ant. 2 purple apically or throughout; ant. 3 and 4 purple. Fore legs with femur pigmented apically and tibiotarsus pigmented near the middle; middle and hind legs with spots of pigment on the precoxae, the femur apically, and the tibiotarsus beyond the middle. Furcula unpigmented. Eyes (fig. 84) sixteen, unequal, the two inner proximal eyes of each side being small and difficult to distinguish. Antennae a little more than twice as long as the head, with segments about as 12 : 28 : 30 : 41, or 8 : 19 : 16 : 27. Mesonotum not projecting over the base of the head. Abd. 4 about 2.2 to 2.4 times as long as abd. 3. Unguis (figs. 85, 86) with three inner pairs of teeth and a pair of lateral teeth. Unguiculus extending about two-thirds as far as the unguis, oblong-lanceolate. Tenent hair a little longer than unguis. Dens one-fourth longer than manubrium, its dorsal crenulations ending before the apex at a distance equal to twice the length of the mucro. Manubrium and dentes densely setaceous on all sides, without scales ventrally. Mucro (fig. 87) with subequal apical and anteapical teeth. Rami of tenaculum quadridentate; corpus with one strong seta, curving distally. Body scales (fig. 88) pale brown, mostly broadly lanceolate to ovate, apically pointed, with long coarsely spaced parallel striae. Length, up to 2.1 mm.

This description agrees essentially with that of the Javanese species, *Sira jacobsoni* Börner (1913*b*, p. 49). The Hawaiian specimens differ from the description by Handschin (1925*b*, p. 237) in not having a metanotal band and in having relatively longer unguiculi. His material came from Sunda Islands.

Honolulu, May 7, 1928, in pineapple soil (J. F. Illingworth); Oahu, November, 1928, in rice straw (R. H. Van Zwaluwenburg); Wahiawa, December 3, 1928, in pineapple soil (J. F. Illingworth).

Specimens.—Cat. No. 43769, U. S. N. M.

Genus LEPIDOCYRTUS Bourlet

KEY TO SPECIES

1. Mesonotum projecting strongly over the head. Apical tooth of mucro very long and slender. A white species.....*heterophthalmus*, p. 68
   Mesonotum not strongly projecting. Apical tooth of mucro short..... 2
2. Iridescent purple or metallic gray.....*cyaneus*, p. 68
   White or pale yellowish..... 3
3. Body white throughout. Abd. 4 three to four times as long as abd. 3 .....*immaculatus*, p. 68
   White or pale yellow when denuded, usually faintly flecked with blue. Abd. 4 one-tenth to six-tenths longer than abd. 3.....*inornatus*, p. 68

Lepidocyrtus heterophthalmus Carpenter.

See Carpenter, 1904, p. 300.

Lepidocyrtus cyaneus Tullberg. (Plate 8, figs. 89-91).

The Hawaiian examples of this species agree with European and North American representatives of the species.

Iridescent purple. (Metallic gray in var. *cinereus* Fols.) Denuded of scales the body is purple, with white intersegmental bands. The bases of the legs are purple, but the femora and tibiotarsi are white. Length, 1.1 mm. See figures 89-91.

For full descriptions of this species refer to Folsom, 1919, p. 14, and 1924, p. 9.

L. cyaneus is a common species in most parts of Europe and North America and is known also from Mexico, Greenland, Siberia, Africa and Bismarck Archipelago.

Pupukea, Oahu, October 1, 1928, in pineapple soil (J. F. Illingworth).

Lepidocyrtus inornatus new species. (Plate 9, figs. 92, 93).

White or pale yellow when denuded of scales, and usually weakly and indefinitely flecked and mottled with blue on the head dorsally and laterally and on th. 2 to abd. 5, inclusive. In the largest individuals these segments are broadly banded with blue dorsally. Antennae bluish throughout. Legs and furcula unpigmented, or legs slightly pigmented basally. Eyes sixteen, subequal. Antennae a little longer than the head (as 1.3 : 1), with segments about as 7 : 12 : 13 : 26. Mesonotum projecting slightly over the occiput. Abd. 4 from one-tenth to six-tenths longer than abd. 3. Unguis (fig. 92) with two pairs of inner teeth and a pair of outer teeth. Unguiculus extending as far as the distal teeth of the unguis, oblong, acute, untoothed. Tenent hair as long as unguiculus, weakly knobbed. Dentes slightly longer than manubrium; both with scales ventrally and abundant fringed setae dorsally; non-annulated region of dens two-thirds longer than the mucro. Mucro (fig. 93) relatively elongate, with long basal spine. Rami of tenaculum quadridentate; corpus with one strong curving anterior seta. Length, 1.5 mm.

Honolulu, May 4, 7, 1928, in pineapple soil (J. F. Illingworth).

Lepidocyrtus immaculatus new species. (Plate 9, figs. 94-96).

White throughout, excepting the black eye spots and the median ocellus. Eyes (fig. 94) sixteen, unequal. Antennae from three-tenths to five-tenths longer than the head. Antennal ratios noted were 8 : 17 : 15 : 30; 6 : 13 : 11 : 27; 6 : 15 : 14 : 31; third segment shorter than the second. Mesonotum not projecting far over the head. Abd. 4 from three to four times as long as abd. 3. Unguis (fig. 95) with two pairs of inner teeth and a pair of lateral teeth. Unguiculus extending three-fifths as far as the unguis, oblong-lanceolate, acute, untoothed. Tenent hair short, equal to unguiculus in length. Furcula with scales ventrally. Dens slightly longer than manu-

brium; dorsal non-annulated region one and one-half times as long as the mucro. Mucro (fig. 96) with long basal spine. Scales apically rounded. Length, 1.2 mm.

This species differs in only a few details from *L. rivularis* Bourl. var. *albicans* Reut., a common species in Europe (Stach, 1922, p. 32). It lacks the antennal coloration of *albicans,* however; ant. 3 is shorter than ant. 2; abd. 3 is relatively shorter than abd. 4; and the non-annulated region of the dens is much shorter than in *albicans*.

Honolulu, October 8, 1927, among pineapple roots (J. F. Illingworth); Oahu and Maui, in cane soil (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43770, U. S. N. M.

Genus Drepanocyrtus Handschin

Drepanocyrtus terrestris new species. (Plate 9, figs. 97-102; Plate 10, figs. 103, 104).

White when denuded of scales; with scales, brownish. Individuals up to about one millimeter in length are entirely white, excepting the eye spots and antennae. Large individuals (fig. 97) may have the mesonotum bordered anteriorly and laterally with purple, with a purple ventro-lateral patch on th. 3, abd. 1, 2 and 3. These patches may extend dorsally (fig. 98), and in the most heavily pigmented specimens may form dorsal bands. Abd. 4 may or may not be pigmented laterally. A purple spot marks the position of the frontal ocellus. Antennal base often ringed with purple; ant. 1 white, or purple apically; ant. 2 purple apically or throughout; ant. 3 white basally or purple throughout; ant. 4 entirely purple. Legs unpigmented except in the largest individuals, in which all the segments may be tinged with purple, with spots on coxae and precoxae. Furcula unpigmented. Eyes (fig. 99) sixteen, unequal, the two anterior eyes on each side being much larger than the others. Antennae two to two and one-half times as long as the head, or three-sevenths as long as the body, with segments about as 7 : 12 : 14 : 13 or 5 : 7 : 8 : 14; none of the segments annulated. Ant. 4 with a terminal tubercle. Mesonotum not projecting over the head. The body segments vary considerably in relative lengths; abd. 4 from 2.25 to 3.9 times as long as abd. 3. Unguis (fig. 100) with three pairs of inner teeth, a pair of small lateral teeth one-third from the base, and an outer tooth slightly more proximal than the last (fig. 101). Unguiculus extending two-thirds as far as the unguis, sublanceolate, acute, untoothed. Tenent hair a little longer than the inner margin of the unguis. All the tibiotarsi are subsegmented, the proximal subsegment being about twice as long as the distal on the first two pairs of legs, and about two and one-half times as long on the hind legs. Furcula attaining the ventral tube. Dentes about one-fifth longer than the manubrium, coarsely crenulate dorsally, the crenulations stopping abruptly; non-crenulated region twice as long as the mucro (fig. 102). Dentes with dorsal setae and ventral scales. Mucrones (figs. 102, 103)

falcate. Rami of tenaculum quadridentate; corpus with one strong anterior seta. Clavate setae occur dorsally in dense clusters on th. 2 and th. 3, and more sparsely on head and abdomen. Extra long, minutely fringed setae occur on the head, first two antennal segments, and the legs, being abundant on femora and tibiotarsi. Body scales (fig. 104) variable in size and form, but mostly broadly elliptical to oval, apically rounded, and closely covered with fine short striae. Length, 1.7 mm; maximum, 2.1 mm.

Several large individuals of this species, taken in the soil among pineapple roots, were entirely white, excepting the eye spots. Even the scales were white.

This species is close to *Pseudosira pseudocaerulea* Denis (1924*b*, p. 244; 1929*a*, p. 104) from Africa and Madagascar. I sent specimens of it to Dr. Denis, who reported that it differs from that species in lacking the basal tooth of the unguiculus, and in having longer inner teeth on the unguis and a different type of scale ornamentation.

He says, however, that this Hawaiian form is even closer to his Costa Rican *Lepidocyrtinus domesticus* (Nic.) *coloratus* (Denis, 1931, p. 142), from which it differs in lacking the teeth of the unguiculus which are characteristic of *domesticus*.

Besides this difference, the Hawaiian form appears to differ from typical *domesticus* of Europe in the relative sizes of the eyes, and in having relatively shorter antennae and fourth abdominal segment (see Denis, 1924*a*, p. 266).

As Dr. Denis says, we do not at present know the range of variation in these forms under consideration; therefore I am placing *terrestris* as a species rather than a variety—for the present, at least.

This species is reported to be very abundant on the surface of pineapple soils under mulching paper, and to feed largely upon decomposing plant refuse. It is common also in the soil, and occurs among pineapple roots. In cane fields the species is found not only in the soil but also on the growing plant, often under leaf sheaths of sugar cane.

Honolulu, March 7, April 5, October 8, 1927; May 4, 7, 9, October 1, 4, 1928 (J. F. Illingworth and R. H. Van Zwaluwenburg); September, 1930 (F. X. Williams); Wahiawa, Oahu, July 28, December 3, 1928 (J. F. Illingworth); Pupukea, Oahu, October 1, 1928 (J. F. Illingworth).

Cotypes.—Cat. No. 43771, U. S. N. M.

Tribe PARONELLINI Börner

Genus SALINA MacGillivray

Cremastocephalus Schött (1896, p. 175) is a synonym of *Salina* MacGillivray (1894, p. 107). See Folsom, 1927, p. 10.

Salina maculata new species. (Plate 10, figs. 105-110).

Salina maculata is yellow, marked with dark purple, almost black. In lateral aspect six large spots, on abd. 2 to 4, inclusive, as shown in figure 105, are constant. Mesonotum bordered with pigment anteriorly and laterally; metanotum and often the first three abdominal terga also bordered laterally. First three antennal segments ringed apically; fourth segment purplish distally. Femur with a distal spot; tibiotarsus with a spot near the base and another beyond the middle. Furcula unpigmented. Eyes (fig. 106) eight on each side, unequal, in two parallel rows, on a common black spot. Antennae from one-fifth to four-fifths longer than the head and body, with segments variable in relative lengths, but averaging 11 : 18 : 14 : 15. Ant. 4 annulate; ant. 2 and 3 obscurely annulate. Mesonotum to fourth abdominal tergite in relative lengths as 14 : 6 : 4 : 8 : 1 : 34. Third abdominal tergite greatly reduced dorsally. Unguis (fig. 107) with two pairs of inner teeth, the distal pair weak. Unguiculus extending three-fourths as far as the unguis, with an inner angle tooth. Tenent hair strong, much longer than the unguis. Furcula almost as long as the body. Dentes longer than manubrium, often one-fifth longer. Mucro trilobed apically, as in figures 108-110. The dorsal apical bladderlike organ of the dens is somewhat obovate in lateral aspect, with usually an apical lobe, and is two-thirds as long as the mucro. Length, 1.9 mm.

This species is closely related to the Indian species *montanus* Imms (1912, p. 105) but differs from the latter in the form of the appendage of the dens, the length of the third abdominal tergite, and the presence of a tooth on the unguiculus. The color pattern of *montanus* was not described; possibly it is indefinite.

Oahu, in soil in cane fields and under leaf sheaths of sugar cane (R. H. Van Zwaluwenburg); Kauai, soil in cane fields (R. H. Van Zwaluwenburg); Kona, Hawaii, March 12, 1928, from coffee leaves (J. F. Illingworth).

Cotypes.—Cat. No. 43772, U. S. N. M.

Tribe CYPHODERINI Börner

Genus CYPHODERUS Nicolet

Cyphoderus assimilis Börner. (Plate 10, figs. 111-112).

White. Eyes absent. Antennae from one-fifth to three-fifths longer than the head, with segments about as 9 : 23 : 14 : 35, or 8 : 19 : 11 : 28.

Abd. 4 about two and one-half times as long as abd. 3. Unguis (fig. 111) almost straight, quadridentate. Of the basal wing-teeth of the unguis, the anterior is narrowly suboblong; the posterior much longer and narrowly triangular. Beyond are two strong teeth. The apex of the claw projects from a membranous tunica. Unguiculus extending three-fourths as far as the unguis, with a large acute outer lobe. Tenent hair as long as the inner border of the unguis. Dens two-thirds as long as manubrium; outer dorsal pinnae 5 to 7, all short; inner dorsal pinnae 5, there being 4 short proximal pinnae and 1 long distal pinna, which extends to the anteapical tooth of the mucro (fig. 112); the outer distal pinna is five-ninths as long as the mucro. Ventroapical scale of dens extending beyond the mucro. Mucro (fig. 112) almost half as long as dens, bidentate, with a narrow lamella extending forward from the anteapical tooth.

This form agrees essentially with the description of *C. assimilis* Börner (1906, p. 181), although the ventro-apical scale under the mucro is longer than in his description, and the posterior wing-tooth of the unguis broader than in his figure (Börner, 1913, p. 277). As in the species referred to *assimilis* by Handschin (1926, p. 460), the unguis has a peculiar apical membrane.

C. assimilis was described from specimens in Germany on orchids from the West Indies. Handschin studied material from Java. I now regard my *C. similis* (Folsom, 1927, p. 12) from Panama as synonymous with *assimilis* Börner.

Honolulu, February, 1930, with *Pheidole* ants (F. X. Williams).

Specimens.—Cat. No. 43773, U. S. N. M.

Subfamily SMINTHURIDINAE Börner

Abd. 5 and 6 ankylosed, broadly joined to abd. 4. Males with clasping antennae ..... SMINTHURIDES

Genus SMINTHURIDES Börner

Sminthurides ramosus new species. (Plate 10, fig. 113; Plate 11, figs. 114-123; Plate 12, figs. 124-126).

FEMALE. Head and body mostly purple. Sternum unpigmented. Antennae dull purple to clear purple throughout. Legs pale, tinged with purple. Manubrium slightly pigmented; dentes unpigmented. Eyes at least twelve (fig. 113), possibly sixteen, on black spots. Antennae subequal to head in length, elbowed between ant. 1 and ant. 2, with segments about as 10 : 16 : 15 : 27 (fig. 114). Ant. 3 organ with a pair of suboval or subreniform lobes as in figures 115 and 116. Ant. 4 not subsegmented. Thoracic segmentation absent dorsally. Genital and anal segments ankylosed

into a single mass. Unguis (fig. 117) slender, with a long inner tooth a little beyond the middle, and a pair of small lateral teeth; the inner tooth is often weak on the hind feet. Unguiculus half as long as the inner margin of the unguis, slender, tapering, with a subapical filament longer than the unguiculus and exceeding the unguis. This filament is distinctly knobbed in some cases, and not in others. Knobbed tenent hairs absent. Tibiotarsal organ of hind legs absent. Vesicles of ventral tube smooth-walled. Dentes with strong curving simple setae dorsally and laterally; ventrally with many short, stiff, appressed setae except basally. Mucro (fig. 118) with outer margin entire, inner margin serrate, and with a baso-lateral seta. Rami of tenaculum tridentate (fig. 119); anterior lobe of corpus with two setae (sometimes three). Head and body with strong stiff spinelike setae (fig. 120). The suranal lobe of the female bears on each side a strong branched seta (fig. 120); a similar seta also occurs dorsally on each subanal lobe. In manner of branching these setae vary considerably (figs. 121, 122). Filiform bothriotricha are present. On each side of the body mass, three antero-dorsal were seen; and on each side, near the base of the ano-genital segment, two dorso-lateral. Integument minutely tuberculate. Length, 1 mm.

MALE. Body and antennae purple. Legs tinged with purple. Furcula unpigmented. Antennae (fig. 123) remarkably stout, one-third longer than the head, with segments as 10 : 9 : 4 : 8. Ant. 2 and 3 are modified to form a complex gripping apparatus of various hooks and lobes (fig. 124). (The antennae of the male grasp those of the female at copulation.) Ant. 4 elliptical, not subsegmented. Each tibiotarsus of the front legs bears basally on the outer side four sense organs (fig. 125), externally elongate, suboblong, thick-walled and slightly elevated. Claws and mucrones similar to those of the female, though the latter (fig. 126) are more slender than in the female. Length, 0.6 mm.

Honolulu, November, December, 1925, in soil of cane fields (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43774, U. S. N. M.

Subfamily SMINTHURINAE Börner

Tibiotarsi with two or three short stout appressed tenent hairs. Anal segment of male with a clasping organ of curving setae.....BOURLETIELLA

Genus BOURLETIELLA Banks

Bourletiella insula new species. (Plate 12, figs. 127-132).

FEMALE. Body dorsally purple with numerous pale spots; postero-laterally with an area of small rounded pale spots; sternum mostly pale. Head purple dorsally; pale orally, and sometimes laterally. Antennae purple throughout. Legs pale, tinged faintly with purple, or pale throughout. Furcula unpigmented, or manubrium with a trace of purple apically. Eyes (fig. 127) sixteen. Antennae a little longer than the head (as 8 : 7), with

segments about as 4 : 8 : 11 : 18. Ant. 4 obscurely annulated, with apparently seven subsegments (fig. 128). Ant. 3 organ (fig. 129) with a pair of contiguous ovate lobes and two guard setae. Anal appendages of female as in figure 130. Unguis (fig. 131) slender, with one inner tooth one-third from the apex (tooth sometimes absent, especially on mid and hind feet). Unguiculus narrowly lanceolate, acuminate, extending from two-thirds to three-fourths (on hind feet) as far as the opposite unguis. Knobbed tenent hairs 3, 3, 3, appressed. Vesicles of ventral tube long, cylindrical, tuberculate. Manubrium and dentes with a few simple dorsal setae; dentes with a few lateral setae also; both naked ventrally. Dens seven-eighths as long as manubrium. Mucro (fig. 132) one-third as long as dens, with both dorsal margins entire. Rami of tenaculum tridentate; ventral lobe elongate, subcylindrical, rounded apically, with four short setae apically. General clothing of short simple curving setae. Length, 1.3 mm.

MALE. Head and body pale yellowish (normally white?), with less purple pigment than in the female. The abdominal postero-lateral area of small rounded spots is extensive. Genital and anal segments purple dorsally, otherwise pale. Antennal segments about as 7 : 12 : 22 : 38. Ant. 1 and 2 pale, purple apically; ant. 3 and 4 purple throughout. Legs and furcula unpigmented. Anal segment with dorsal hooked setae modified for clasping. Length, 0.8 mm.

Honolulu, April 23, November, 1925, in cane soil (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43775, U. S. N. M.

Subfamily DICYRTOMINAE Börner

Ant. 3 and 4, or only ant. 3, subsegmented. Dentes with serrate setae ..... PTENOTHRIX

Genus PTENOTHRIX Börner

Ptenothrix dubia new species. (Plate 12, figs. 133-136).

Variegated with olive, brown, purple and white. Body mostly brown dorsally, spotted with pure white (figs. 133, 134). On the anterior half of the dorsum (fig. 134) there is a median lanceolate translucent pale area bordered on each side with a row of chocolate-brown spots, which in turn are bordered laterally with irregular white spots. Head mostly blackish purple. Vertex with elliptical white spots between the eyes. Antennae (fig. 133) blackish with four white bands, as follows: on ant. 2, basally and apically; on ant. 3 subapically; and on ant. 4 basally. Legs (fig. 133) mostly purple beyond coxae; tibiotarsi white on distal three-fifths and sometimes at base; femora with an outer white streak. Ventral tube blackish purple. Manubrium and dentes purple throughout. Eyes sixteen. Antennal segments in relative lengths about as 5 : 21 : 24 : 7. Ant. 3 annulate on distal half, ant. 4 annulate throughout. Posterior part of abdomen with a large median-dorsal rounded tubercle (fig. 133), bearing numerous short stiff setae. Unguis (fig. 135) long and slender, with two strong inner teeth

and two pairs of small lateral teeth. Unguiculus extending half as far as the unguis, sublanceolate, with subapical filament exceeding the unguis, and with long slender inner tooth. Knobbed tenent hairs absent. Vesicles of ventral tube cylindrical, tuberculate. Manubrium naked ventrally. Dentes naked ventrally except distally; dorsally with numerous long stiff setae, the last three to five of which are basally serrate (fig. 136). Mucro (fig. 136) with both dorsal margins serrate. Clothing of short simple setae. Integument granulate. Length, 2.3 mm.

This species, with its characteristic dorsal tubercle, may be *Ptenothrix mirabilis* Denis (1929*b*, p. 319), described from China. Additional material from China is desirable, as that studied by Dr. Denis was in too poor condition to show the color pattern.

Two of Denis' specimens had the dorsal tubercle and two did not have it; though all four seemed to be the same species. Denis suggests, therefore, that the species is sexually dimorphic, and that the individuals with the tubercles are the females.

The material of *P. dubia* consists of four individuals, all of which have the dorsal tubercle.

Hering Valley, Tantalus, Honolulu, December 31, 1929, on damp boulder (F. X. Williams).

Cotypes.—Cat. No. 43776, U. S. N. M.

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Explanation of Plates

PLATE 1

Schöttella alba

Fig. 1. Eyes and postantennal organ of right side. Fig. 2. End of right antenna, dorsal aspect. Fig. 3. Right hind foot. Fig. 4. Right dens and mucro.

Xenylla sensilis

Fig. 5. Eyes of left side. Fig. 6. Sense organ of third antennal segment of right side. Fig. 7. Apex of right antenna, dorsal aspect. Fig. 8. Right fore foot. Fig. 9. Concave aspect of unguis. Fig. 10. Anal spines. Fig. 11. Left dens and mucro. Fig. 12. Right mucro. Fig. 13. Dorsal setae of metanotum.

PLATE 2

Xenylla alba

Fig. 14. Eyes of right side. Fig. 15. Sense organ of third antennal segment of right side. Fig. 16. Apex of right antenna, dorsal aspect. Fig. 17. Right hind foot. Fig. 18. Anal spine. Fig. 19. Left dens and mucro. Fig. 20. Right dens and mucro.

Stachia minuta

Fig. 21. Lateral aspect. Fig. 22. Left eye and base of antenna. Fig. 23. Left eye and postantennal organ. Fig. 24. Mandible. Fig. 25. Maxilla. Fig. 26. Dorsal aspect of anal segment.

PLATE 3

Stachia minuta

Fig. 27. Suranal and subanal valves. Fig. 28. Extremity of left fore foot. Fig. 29. Furcula, dorsal aspect. Fig. 30. Furcula, left aspect.

Protanura capitata

Fig. 31. Dorsal aspect. Fig. 32. Sense organ of third antennal segment of right side. Fig. 33. Extremity of right antenna, dorsal aspect. Fig. 34. Head of right mandible. Fig. 35. Head of right maxilla. Fig. 36. Left hind foot.

PLATE 4

Tullbergia silvicola

Fig. 37. Dorsal aspect. Fig. 38. Left postantennal organ with pseudocellus. Fig. 39. Sense organ of third antennal segment of right side. Fig. 40. Left hind foot. Fig. 41. Left anal spine.

Folsomides exiguus

Fig. 42. Lateral aspect. Fig. 43. Eyes and postantennal organ of left side. Fig. 44. Mandible. Fig. 45. Left hind foot. Fig. 46. Right fore foot. Fig. 47. Left aspect of manubrium and mucrodens.

PLATE 5

Isotomodes denisi

Fig. 48. Lateral aspect. Fig. 49. Left postantennal organ. Fig. 50. Sense organ of third antennal segment of left side, in optical cross section. Fig. 51. Same, surface aspect. Fig. 52. Ventral aspect of extremity of left antenna. Fig. 53. Head of mandible. Fig. 54. Head of maxilla. Fig. 55. Left hind foot. Fig. 56. Left dens and mucro.

Denisia falcata

Fig. 57. Lateral aspect.

PLATE 6

Denisia falcata

Fig. 58. Lateral aspect of extremity of left antenna. Fig. 59. Left hind foot. Fig. 60. Right mucro and part of dens. Fig. 61. Left mucro. Fig. 62. Clothing of abd. 2.

Proisotoma nigromaculosa

Fig. 63. Eyes, postantennal organ and base of antenna of left side. Fig. 64. Right hind foot. Fig. 65. Left mucro. Fig. 66. Left mucro.

Isotoma minor

Fig. 67. Extremity of left antenna. Fig. 68. Extremity of left antenna. Fig. 69. Left hind foot. Fig. 70. Left mucro. Fig. 71. Dorsal setae, abd. 2.

PLATE 7

Entomobrya multifasciata imminuta

Fig. 72. Lateral aspect. Fig. 73. Eyes of left side. Fig. 74. Right hind foot. Fig. 75. Left mucro and end of dens.

Entomobrya lactea

Fig. 76. Eyes of left side. Fig. 77. Left hind foot. Fig. 78. Left mucro and end of dens.

Sinella höfti

Fig. 79. Right hind foot. Fig. 80. Subclavate seta of hind tibiotarsus. Fig. 81. Left mucro and end of dens.

PLATE 8

Sira jacobsoni

Fig. 82. Dorsal aspect. Fig. 83. Dorsal aspect. Fig. 84. Eyes of left side. Fig. 85. Right mid foot. Fig. 86. Right mid foot. Fig 87. Left mucro and end of dens. Fig. 88. Body scale.

Lepidocyrtus cyaneus

Fig. 89. Left aspect of mesonotum. Fig. 90. Right hind foot. Fig. 91. Left mucro and end of dens.

PLATE 9

Lepidocyrtus inornatus

Fig. 92. Left hind foot. Fig. 93. Left mucro and end of dens.

Lepidocyrtus immaculatus

Fig. 94. Eyes of right side. Fig. 95. Right hind foot. Fig. 96. Right mucro and end of dens.

Drepanocyrtus terrestris

Fig. 97. Lateral aspect. Fig. 98. Lateral aspect. Fig. 99. Eyes of right side. Fig. 100. Left hind foot. Fig. 101. Unguis. Fig. 102. Mucro and end of dens.

PLATE 10

Drepanocyrtus terrestris

Fig. 103. Left mucro and end of dens. Fig. 104. Typical body scale.

Salina maculata

Fig. 105. Lateral aspect. Fig. 106. Eyes of right side. Fig. 107. Left mid foot. Fig. 108. Right mucro. Fig. 109. Left mucro. Fig. 110. Right mucro.

Cyphoderus assimilis

Fig. 111. Left hind foot. Fig. 112. Left mucro.

Sminthurides ramosus

Fig. 113. Eyes of left side.

PLATE 11

Sminthurides ramosus

Fig. 114. Left antenna of female. Fig. 115. Sense organ of third antennal segment of left side, female. Fig. 116. Same as No. 115. Fig.

117. Right fore foot of female. Fig. 118. Left mucro of female. Fig. 119. Left aspect of tenaculum, female. Fig. 120. Left aspect of suranal and left subanal lobes of female. Fig. 121. Branched seta of left subanal lobe of female. Fig. 122. Same as No. 121. Fig. 123. Left antenna of male.

PLATE 12

Sminthurides ramosus

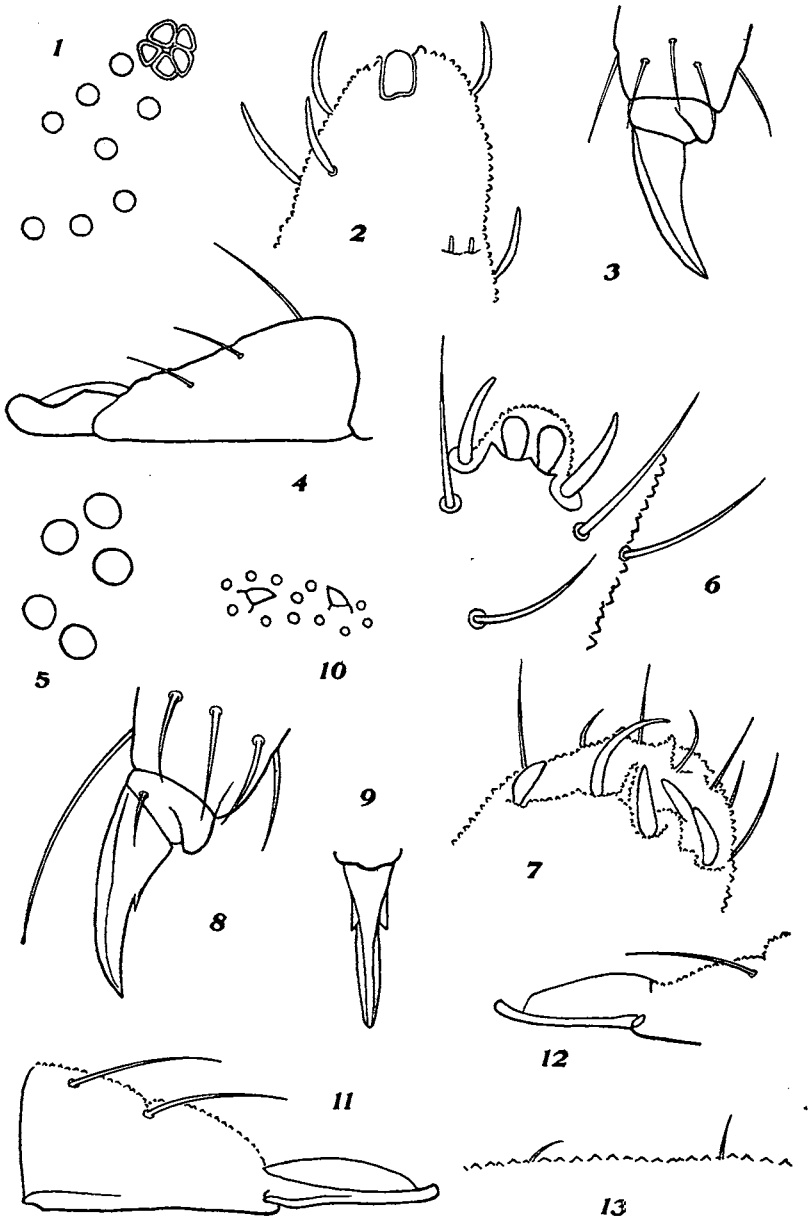
Fig. 124. Second and third segments of left antenna of male. Fig. 125. Base of front tibiotarsus of male. Fig. 126. Left mucro of male.

Bourletiella insula

Fig. 127. Eyes of left side. Fig. 128. Fourth antennal segment of female. Fig. 129. Sense organ of third antennal segment of left side. Fig. 130. Left subanal appendage of female, lateral aspect. Fig. 131. Left fore foot. Fig. 132. Left mucro.

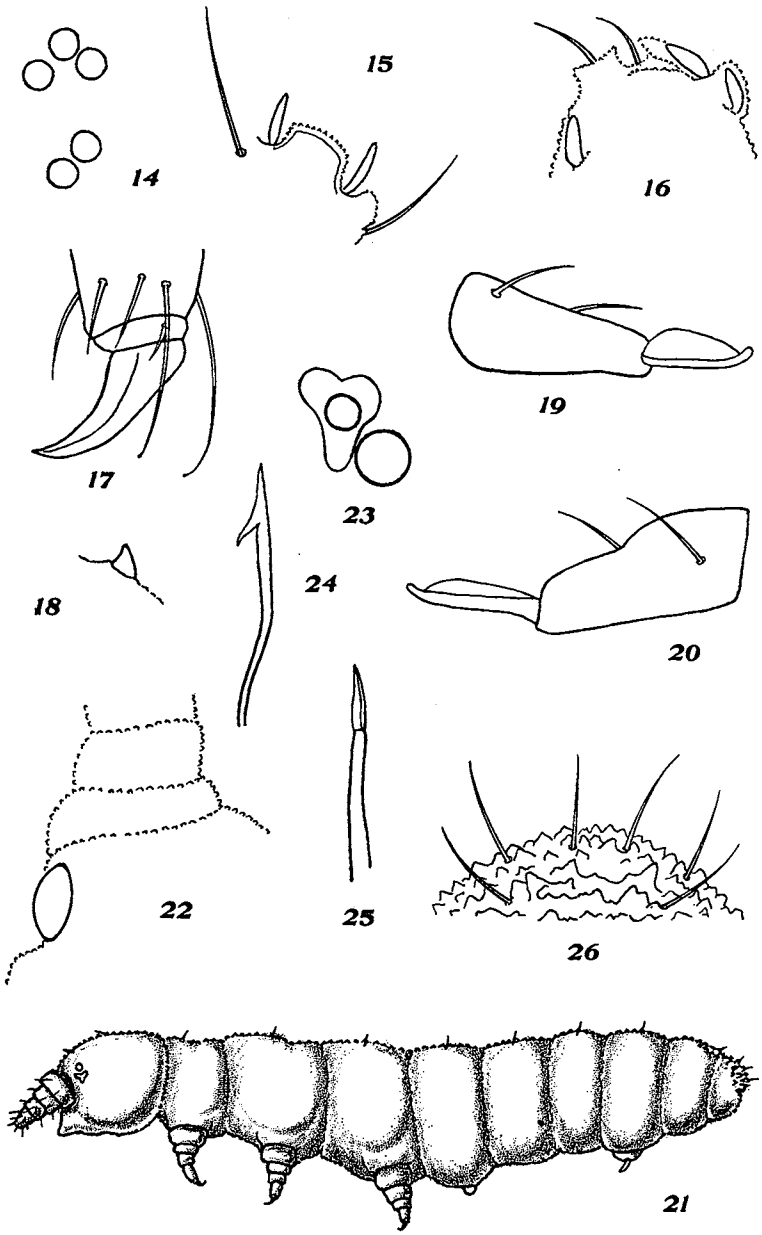
Ptenothrix dubia

Fig. 133. Lateral aspect. Fig. 134. Dorsal aspect of body. Fig. 135. Left hind foot. Fig. 136. Left mucro.



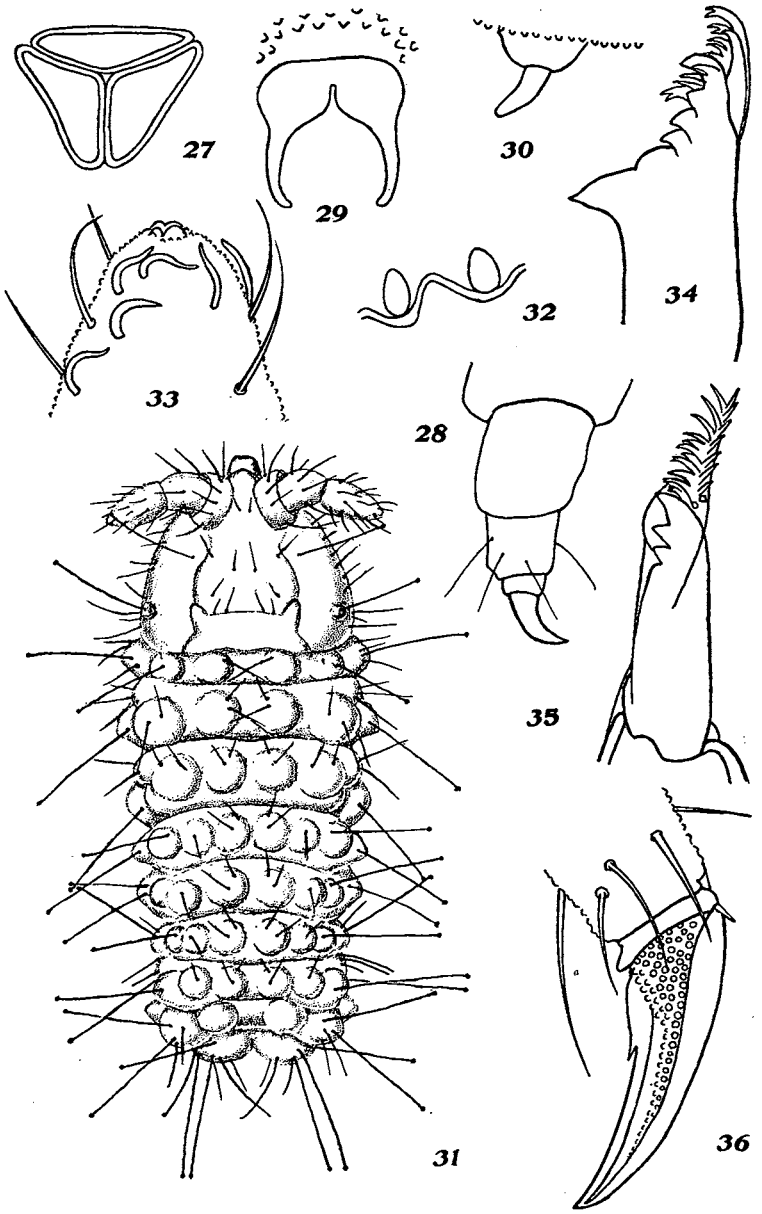
Folsom. Hawaiian Collembola

1-4. *Schöttella alba*
5-13. *Xenylla sensilis*



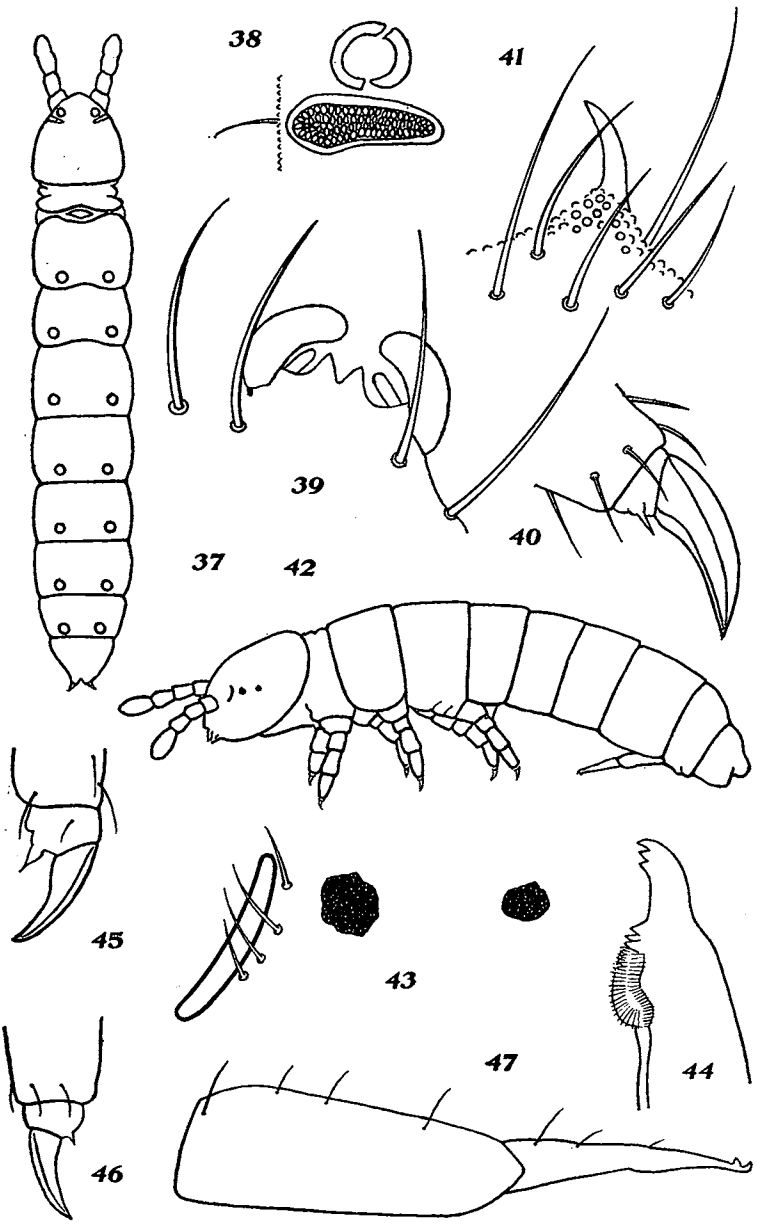
Folsom. Hawaiian Collembola

14-20. *Xenylla alba*
21-26. *Stachia minuta*



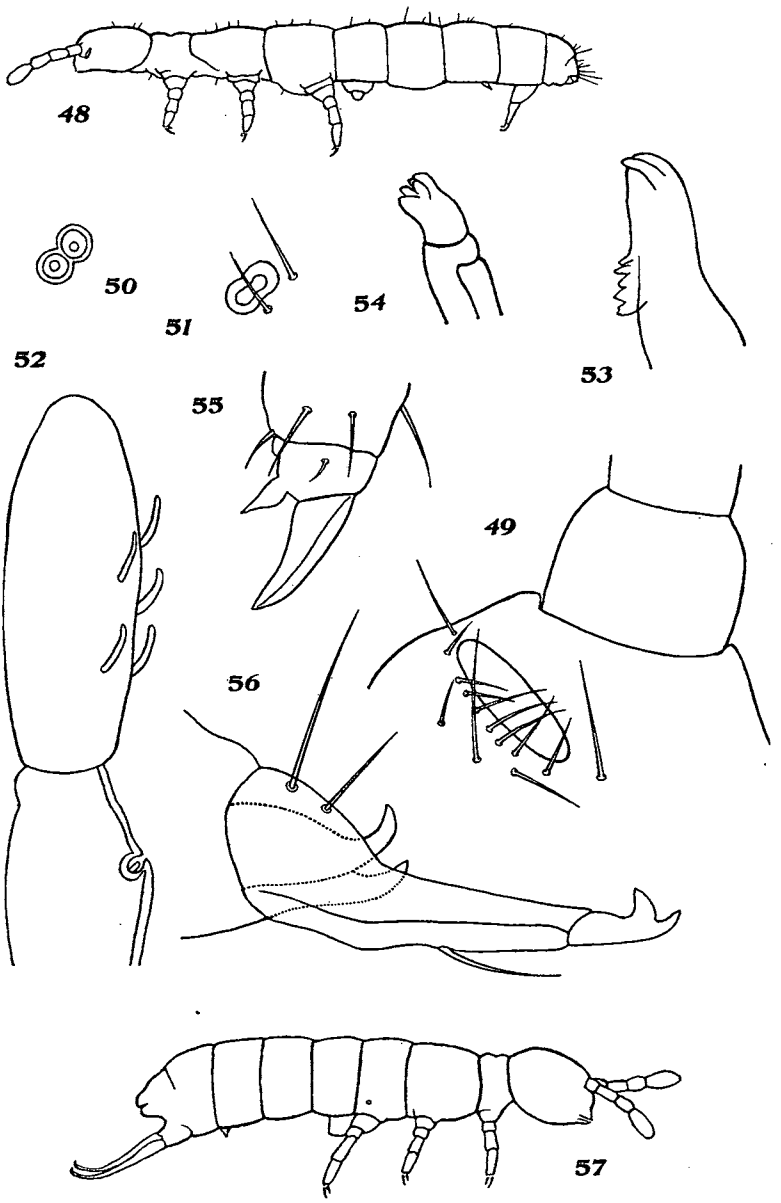
Folsom. Hawaiian Collembola

27-30. *Stachia minuta*
31-36. *Protanura capitata*



Folsom. Hawaiian Collembola

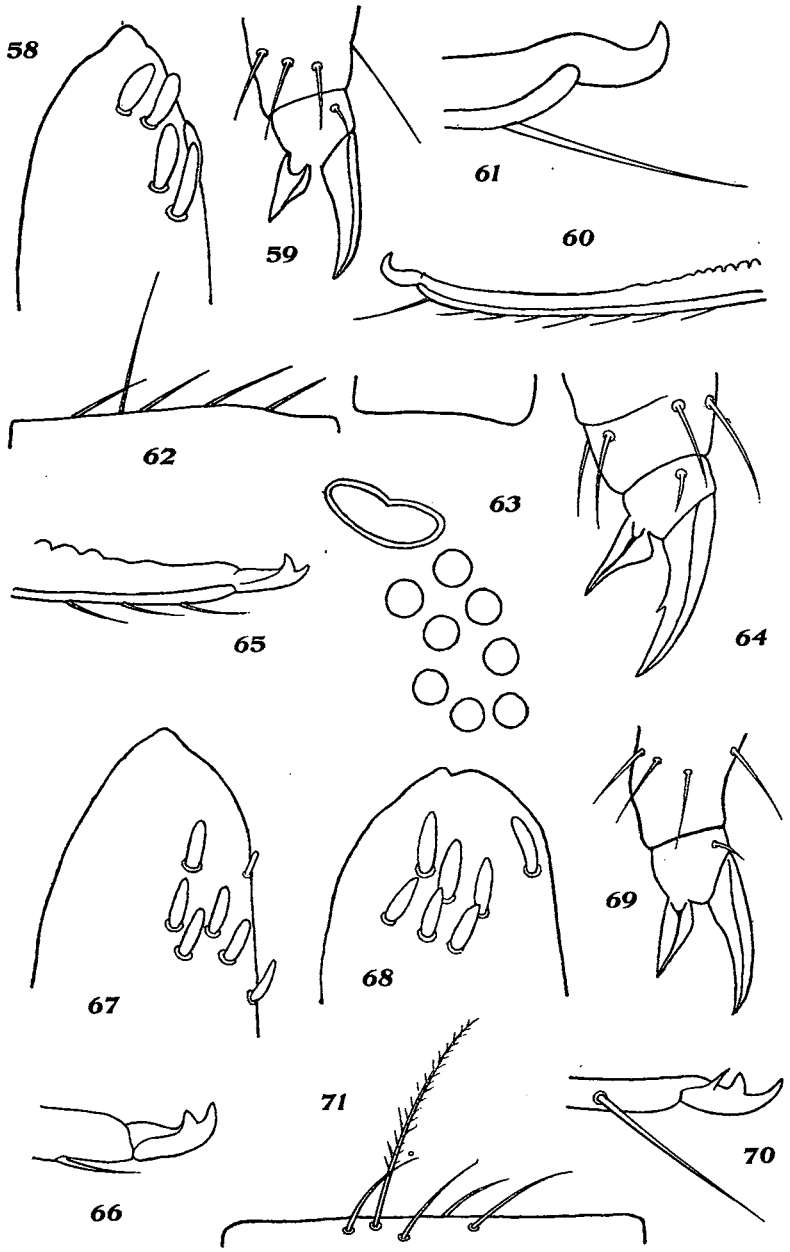
37-41. *Tullbergia silvicola*
42-47. *Folsomides exiguus*



Folsom. Hawaiian Collembola

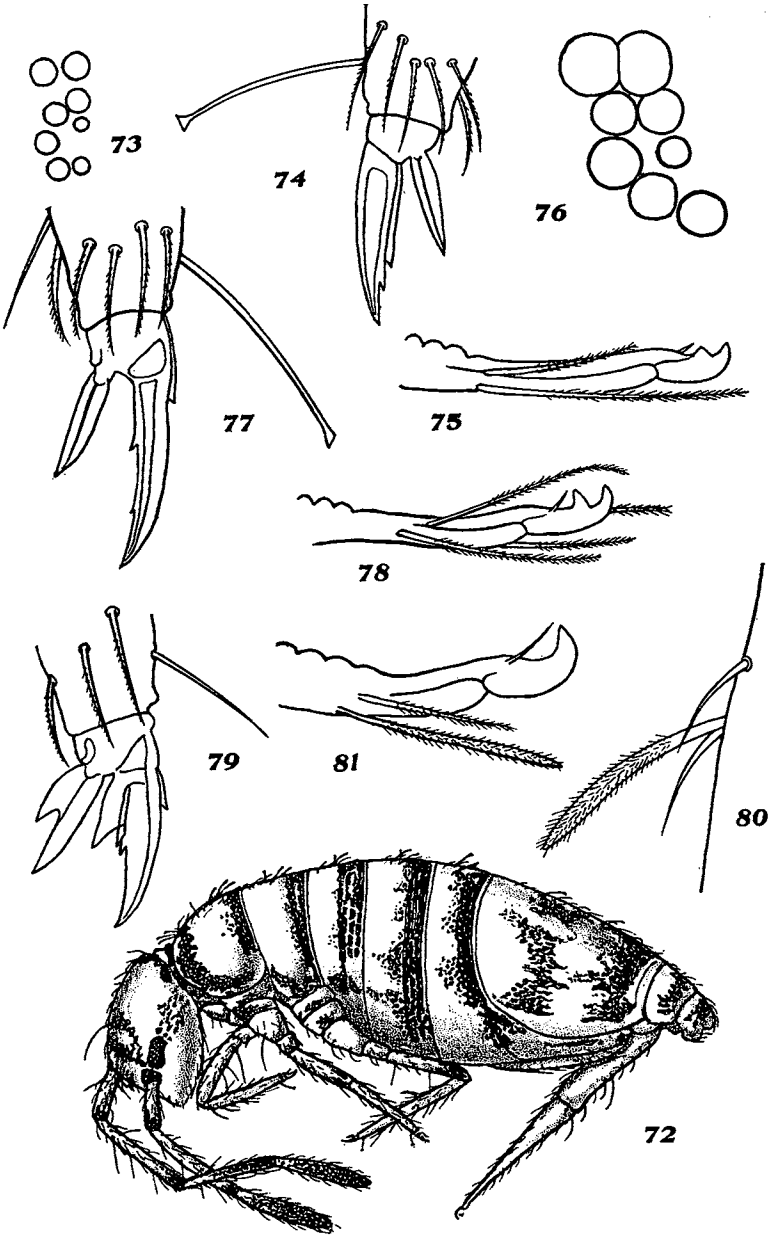
48-56. *Isotomodes denisi*

57. *Denisia falcata*



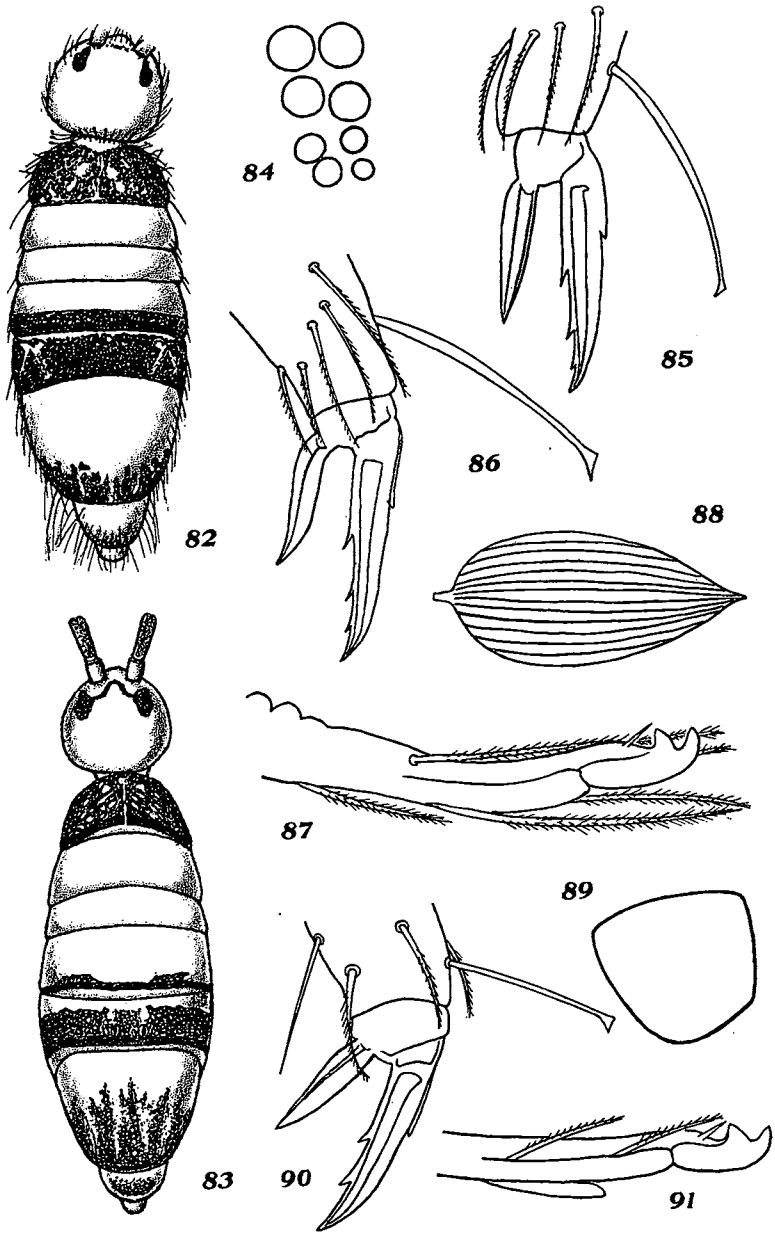
Folsom. Hawaiian Collembola

58-62. *Denisia falcata*
63-66. *Proisotoma nigromaculosa*
67-71. *Isotoma minor*



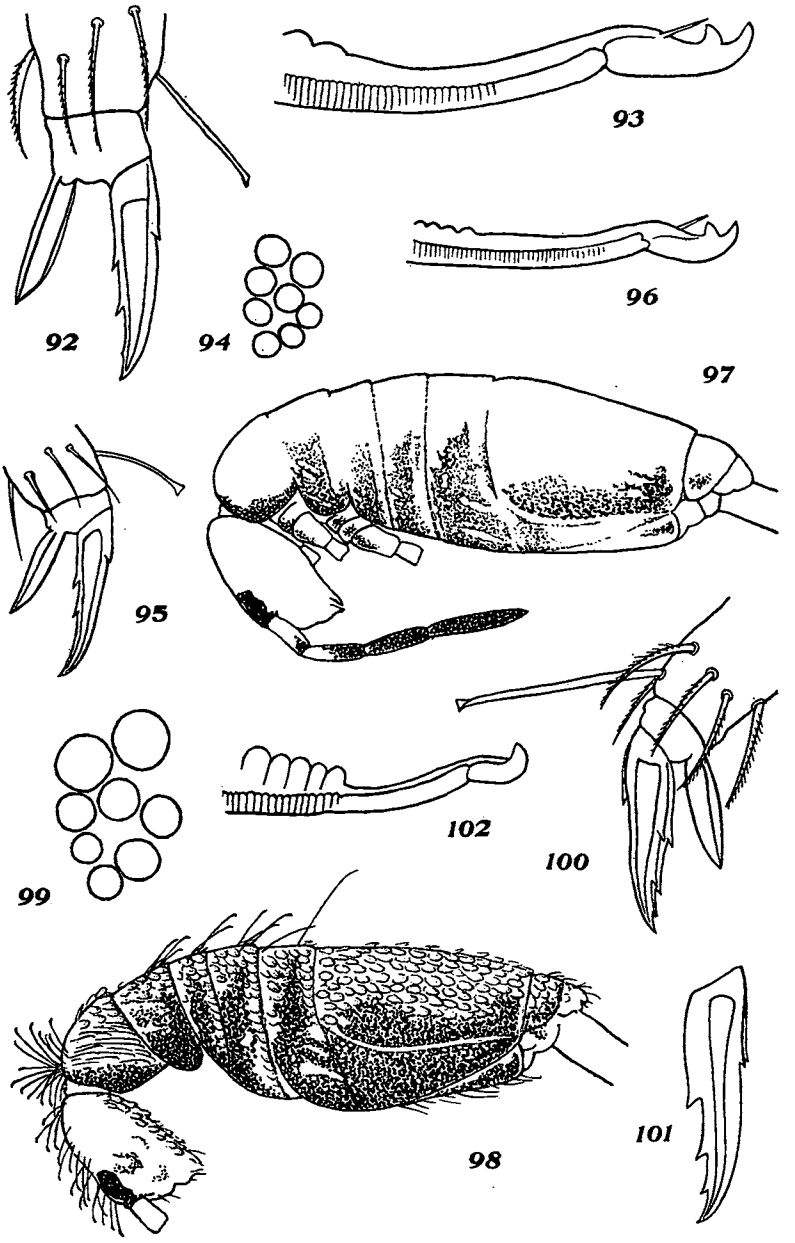
Folsom. Hawaiian Collembola

72-75. *Entomobrya multifasciata inminuta*
76-78. *Entomobrya lactea*
79-81. *Sinella höfti*



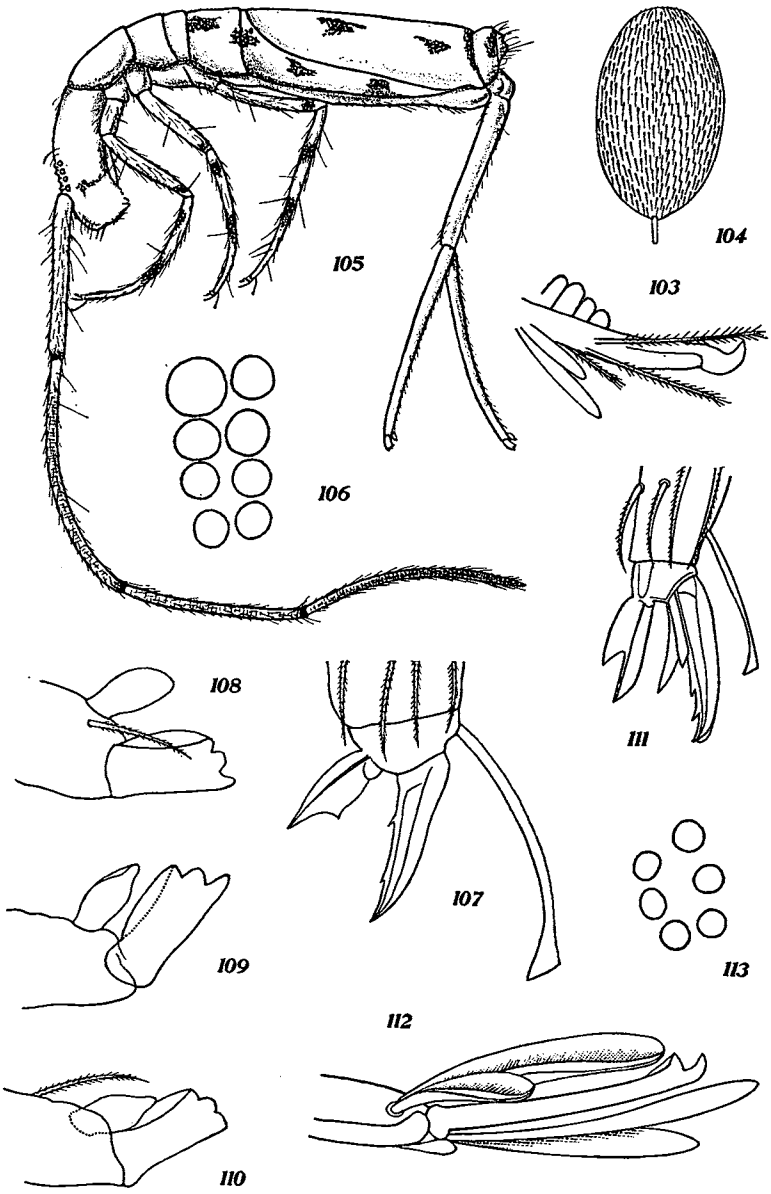
Folsom. Hawaiian Collembola

82-88. *Sira jacobsoni*
89-91. *Lepidocyrtus cyaneus*



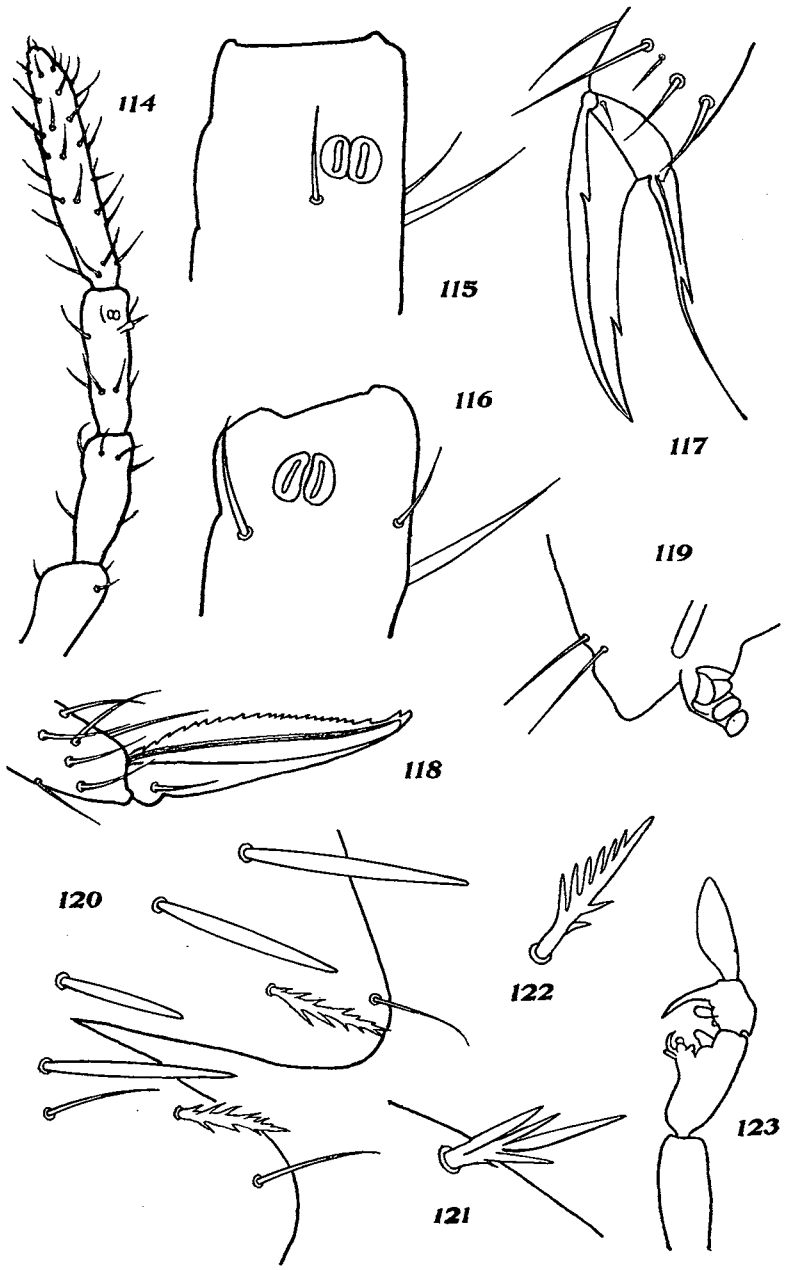
Folsom. Hawaiian Collembola

92-93. *Lepidocyrtus inornatus*
94-96. *Drepanocyrtus immaculatus*
97-102. *Drepanocyrtus terrestris*



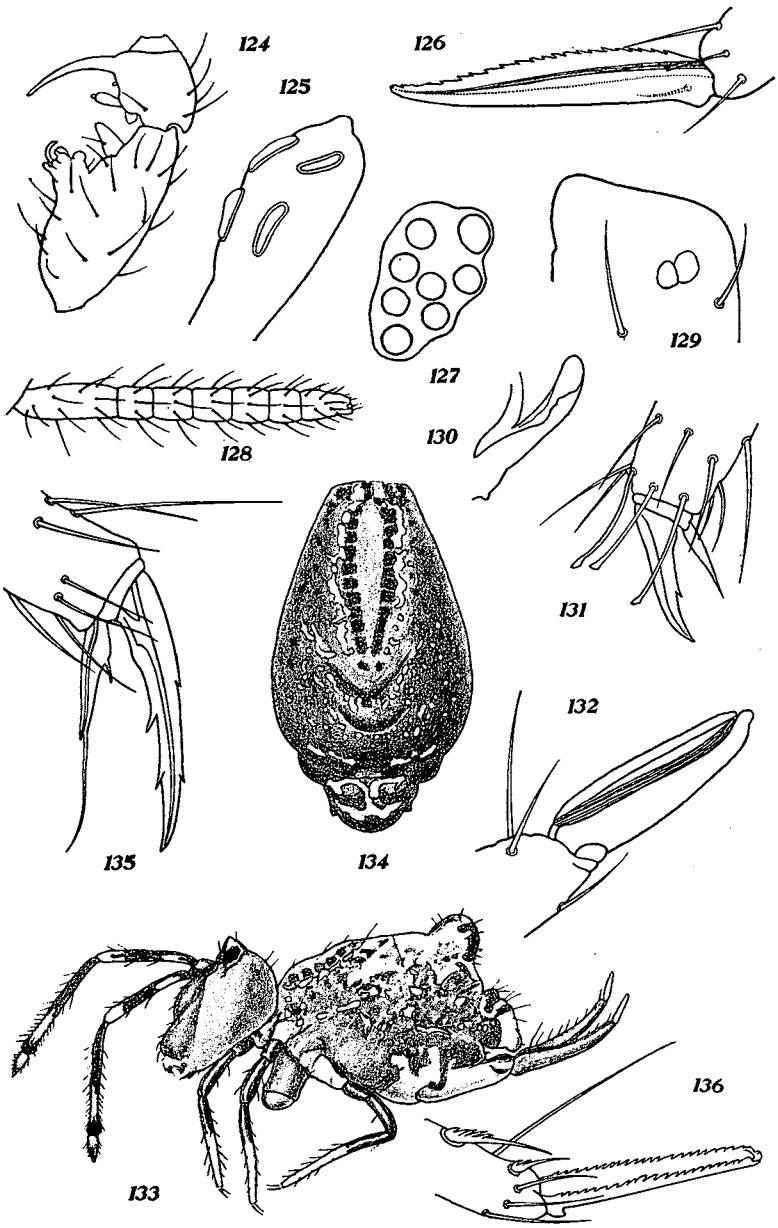
Folsom. Hawaiian Collembola

103-104. *Drepanocyrtus terrestris*
105-110. *Salina maculata*
111-112. *Cyphoderus assimilis*
113. *Sminthurides ramosus*



Folsom. Hawaiian Collembola

114-123. *Sminthurides ramosus*



Folsom. Hawaiian Collembola

124-126. *Sminthurides ramosus*
127-132. *Bourletiella insula*
133-136. *Ptenothrix dubia*